THE MAC Flyer

September 1984

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THE MAC Flyer

For Greater Safety in MAC Air Operations

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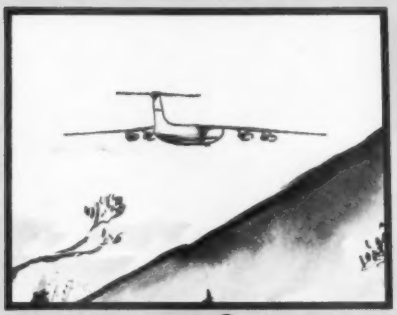

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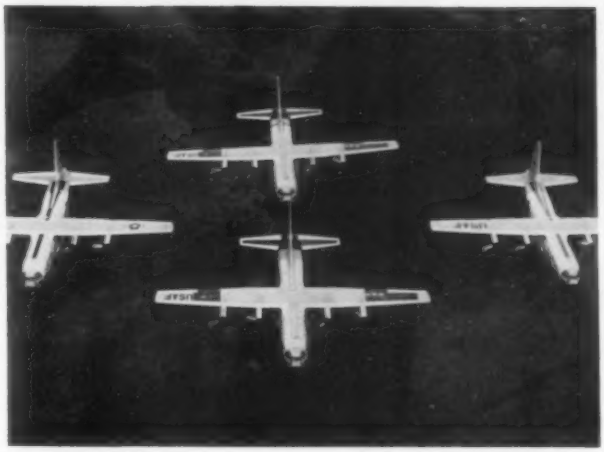
HERK—THE FIRST 30 YEARS

by Capt. Byron L. Howard
Associate Editor

With the summer olympics over and many records shattered, we at *TMF* feel obligated to underscore a record of a different type. You see, on 23 August 1954—30 years ago—the first of over 1,700 Lockheed C-130s took to the sky for its maiden flight. For those of us who have flown the Herk, that date ranks up there with wedding anniversaries, birthdays, first solo flights, etc., and there are really only a handful of airplanes, especially trash hauling-type airlift aircraft, that elicit that special kind of feeling. But modern-day aircraft don't seem to last long enough. Like a meteor, they burst upon the scene, shine brilliantly for a short time, and are gone. Not so the Herk!

Birth of a Legend

In 1950, as America was once again caught unprepared for a major conflict, communist North Korean troops surged across the 38th parallel and almost pushed allied troops into the sea. Agonizing days and weeks passed until United States and United Nations forces finally arrived to turn things around. As the conflict continued, Department of Defense officials and leaders of the still-new Air Force started to plan for a new cargo plane. They hoped industry could somehow design an aircraft that could haul men and equipment across oceans, drop them, and then continue to resupply the troops either by airdrop or airland. The plane they envisioned had to be capable of cruising at "jet speeds" while also being able to drop troops at 125 knots! In 1951, no plane could meet those requirements.

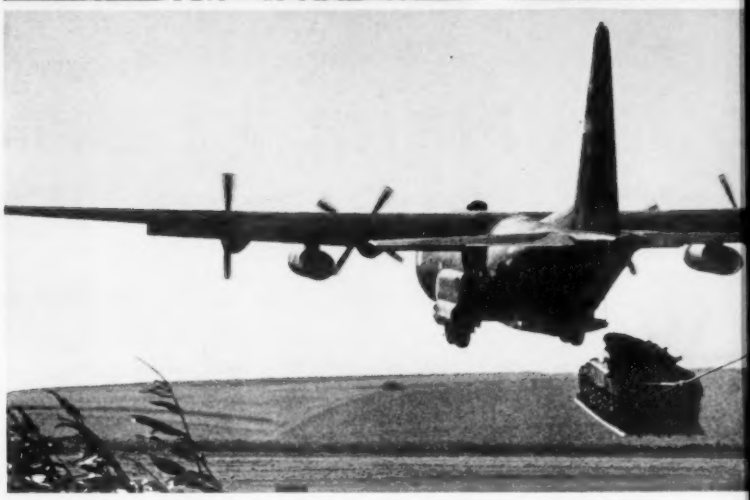


So, on 2 February 1951, the Air Force issued its General Operational Requirement, and Requests for Proposals (RFP) went out to Boeing, Douglas, Fairchild and Lockheed. What the Air Force asked for was an airplane that was part tramp steamer and part boxcar; part hummingbird and part hawk. It would have to combine the best qualities of a camel, an ox and a burro. The Air Force was asking for a "super" plane.

Still, on 2 July, five months to the day since issuing its RFP, Air Force officials announced that Lockheed and its Model L-206 had won the competition.

Innovations

As put down on the drawing boards at Lockheed's Burbank, California, plant, this plane was like no other before it. In order to have instant power when it would be needed most—airdrops, short-field takeoffs, etc.—Lockheed designers decided to go with a strange (for that time) combination powerplant called the turboprop. Extremely efficient, the four Allison T56-A-1As would be



linked to three-bladed, variable-pitch propellers to give the ungainly looking airlifter a top speed of 360 miles per hour—"jet speeds."

The airframe design was highly innovative. The long, angular wing sat atop a fuselage that was flattened slightly, and roughly the size of a railroad car—10x9x60. That massive amount of space was also to be pressurized, which was nothing special. Nothing special, that is, unless you cut a great big hole in the rear of the tube so you could airdrop large amounts of machinery and material. Now put that cargo floor only 45 inches above the ground at truck-bed height to ease your loading problems, and you have a C-130 fuselage.

The landing gear was very unusual. Lockheed opted for a tandem-wheel main gear which retracted into pods on the side of the fuselage. The first low-pressure tire would pack the ground for the second to roll over. Thus, any semi-hard ground with a texture approaching that of loose sand could be used for landing.

A roomy "green house" of a cockpit was designed to give the crew an almost unobstructed view of the runway—20°of downward visibility, to be exact. This openness, again unusual for a cargo airplane of that time, became a trademark for the Herk, and resulted in the characteristic A-model "Roman nose."

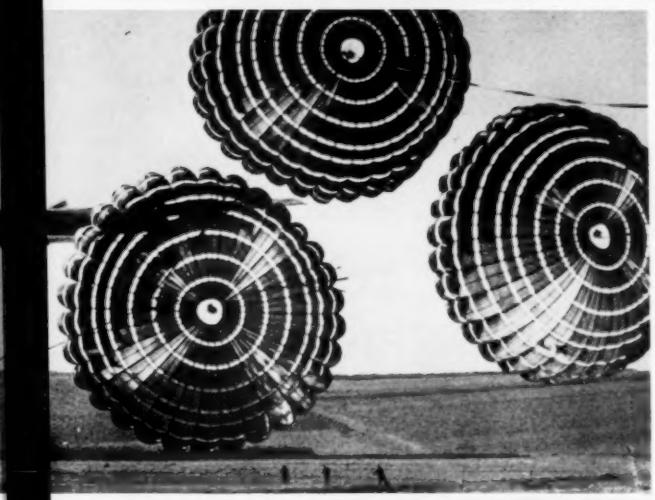
When the prototypes were rolled out, Lockheed designers had surpassed their own estimates. The YC-130 weighed in at a mere 108,000 pounds instead of the originally proposed 113,000 pounds. The empty weight of the first Herk was a feather-like 57,000 pounds. When coupled to 15,000 horses, the prototype was almost bound to leap off the ground.

Finally, the anticipation was over. On 23 August 1954, Lockheed test pilot Stanley Beltz guided the aircraft, the first of many, into the air over Burbank, California, and the legend of the C-130 began. Sixty-one minutes later, Lockheed serial number 1001 was back on the ground. Beltz led the jubilant flight crew off the airplane after the big props had finally wound down.

"I never saw such an eager airplane," he told a cluster of people who met him. "She's a real flying machine."

Nobody then could have possibly foreseen the non-stop production of the C-130. Nobody could have predicted the number of conflicts where the venerable aircraft has played a key role in determining the outcome. With a continuous production run of some 29 years, give or take a month or two,

The accompanying photos show the Herk in some of its many configurations and missions.



and still coming off the assembly line at Marietta, Georgia, it appears the C-130, in one shape, form or fashion, will continue its production run into the 21st century.

Many Models

Since the first A-model (AF-33129, later changed to 53-129), the prefixes and suffixes have changed any number of times. There have been (to the best of our knowledge) AC, CC, DC, EC, GC, HC, JC, KC, LC, MC, NC, RC, WC, and YC-130s. There have been A, B, D, E, F, G, H, J, K, N, Q, P, and R model Herks, with plans for a C-130 "Z".

The Herk can be flown comfortably from a couple of feet AGL, as in a LAPES extraction, all the way to FL440 for a HALO drop. They've even kept an MC-130 airborne for almost 28 hours! Back in 1963, a KC-130F even landed on the deck of the carrier *Forrestal*. The Herk is still the largest airplane ever to take off and land on a carrier—unassisted!

Besides dropping men and equipment, C-130s also pick up things, sometimes right out of mid air. The C-130 has been "snatching-and-grabbing" satellites for years. Some Herks employ the Fulton Recovery System for picking up stranded aviators and other personnel on the ground. Using a grappeling hook, the Royal Air Force Herks were even used to pick up mail bags from the ground during the Falkland Islands crisis.

The first C-130s are still flying in their original colors, too. Well, almost original colors. The *City of Ardmore*, the first operational Herk to enter Tactical Air Command's 463d Troop Carrier Wing at Ardmore, Oklahoma, is still flying with the 928th Tactical Airlift Group (AFRES) out of Chicago-O'Hare. Old 129, the first aircraft delivered to the Air Force, is also flying with the Air Force Reserves as an AC-130 gunship at Duke Field, Florida. It's easy to contrast these "old timers" with the Air National Guard's newest acquisition at Kulis ANG Base, Alaska. Their 1983 H-models are still "wet behind the ears" as airplanes go.

Continued Improvements

Even as we go to press with this issue, we're having trouble documenting the changes going on down at Marietta. Seems the folks down there are now installing new, fatigue-fighting seats, after-body strakes to reduce drag and improve fuel economy, and new fuel probes to keep the airplane up-to-date. Future improvements call for adding a new "glass cockpit" including electronic display flight instruments. Newer, more powerful, and more fuel efficient engines are also on the horizon.

Safety First

In May, the Air Force recorded its 10-millionth hour of C-130 operations. Against 134 mishaps, that yields a mishap rate of 1.34 per 100,000 flying hours. Not bad for an airplane called on to do so many diverse, often hazardous missions. As a former *TMF* supervising editor said in an article, "Sure the Hercules was *strong*— but who could have known that a short-haul tactical bantam rooster would have roles of attack, recon, rescue, strategic airlifter and aerial refueler." It's also been a bomber, hay-hauler, airshow star, and a flying fire truck. Like the mythical hero the airplane was named after, the labors of the C-130 have never ended; indeed, they've just begun. We at *TMF* wish the Herk continued success and a happy birthday!

Flyers Forum

by Lt. Col. Edward B. Borden, USAFR
HQ MAC/PAM
Scott AFB, Illinois

"Aardvark approach, MAC 9061 is ready for descent."

"MAC 9061, Aardvark approach. Descend and maintain one one thousand. Report passing flight level one niner zero. Aardvark altimeter, three zero zero niner."

"Roger, departing two three zero for niner thousand, altimeter three zero zero niner."

"Crew, prepare for descent."

"Pilot, copilot. Don't forget Moon Mountain to the east of the field."

"Rog. How about checking for traffic? Descent checklist."

"Aardvark approach, MAC 9061. Any traffic on our descent?"

"MAC 9061, Aardvark approach. You have a charlie one-thirty at one zero thousand, twelve o'clock, four miles, heading 330."

"Roger, please keep MAC 9061 advised."

MAC 9061, a C-141, continued a gentle descent to 9,000 feet. Suddenly the aircraft commander asked, "Hey! What altitude did the controller say to report?"

"Eleven thousand...I think," replied the copilot.

"No, it was 15," said the flight engineer.

"It was...oh, darn! I was concentrating on traffic and the obstacles," the observer interjected from the jump seat.

"Let me check," sighed the copilot. "Aardvark approach, this is MAC 9061..."

The C-141 passed through FL 190 without reporting, didn't hear approach control's frantic directions to turn right *immediately* to 090 degrees, and continued on a near-collision course with the C-130. Only when the two aircraft were less than one mile apart and the Starlifter passed *through* 10,000 feet were communications restored with approach and an immediate turn made.

All the crew got out of the incident was a violation for busting their altitude, but 12 crewmembers could have been killed and two aircraft destroyed.

A fictional scenario? Maybe. But it points out a very real hazard in multi-place aircraft.

The most dangerous phases of any flight are departures and approaches. There are also many factors present that can disrupt your concentration and the smooth flow of procedures and can halt the process of safely transforming your bird from an *air* machine to a *ground* machine, and vice versa.

Sure, some crewmembers say, we're doing okay. We can move this baby safely with a minimum crew. We've proved it for years, now. Look at the C-9s and the commercial birds. They don't have that extra set of eyes available in the jump seat.

They're right, in a way. But what about tomorrow? And the complacency? Getting on the airway or on the runway is one of our most important jobs, and the better we do it, the safer everyone will be. And the more people helping, the better.

The following tips might help you do your job more smoothly (and safer).

- Take a few minutes to talk to the other crewmembers and find out what expertise they have or don't have.
- Copy *all* clearances. Repeat them verbatim, when practical, to the controller. If possible, have two people copy them. A quick check over interphone between what two skilled people *thought* they heard may make a difference.
- Put your most reliable observers in the jump seat. Their eyes and ears just may keep you out of serious trouble.
- Take your time with departure and approach briefings. Make sure everybody understands what you're going to do. Leave time for questions.

● Encourage your crew to stay up with the altitude and route clearances, radio frequencies and status of the checklists. Make *sure* they speak up if something doesn't seem right.

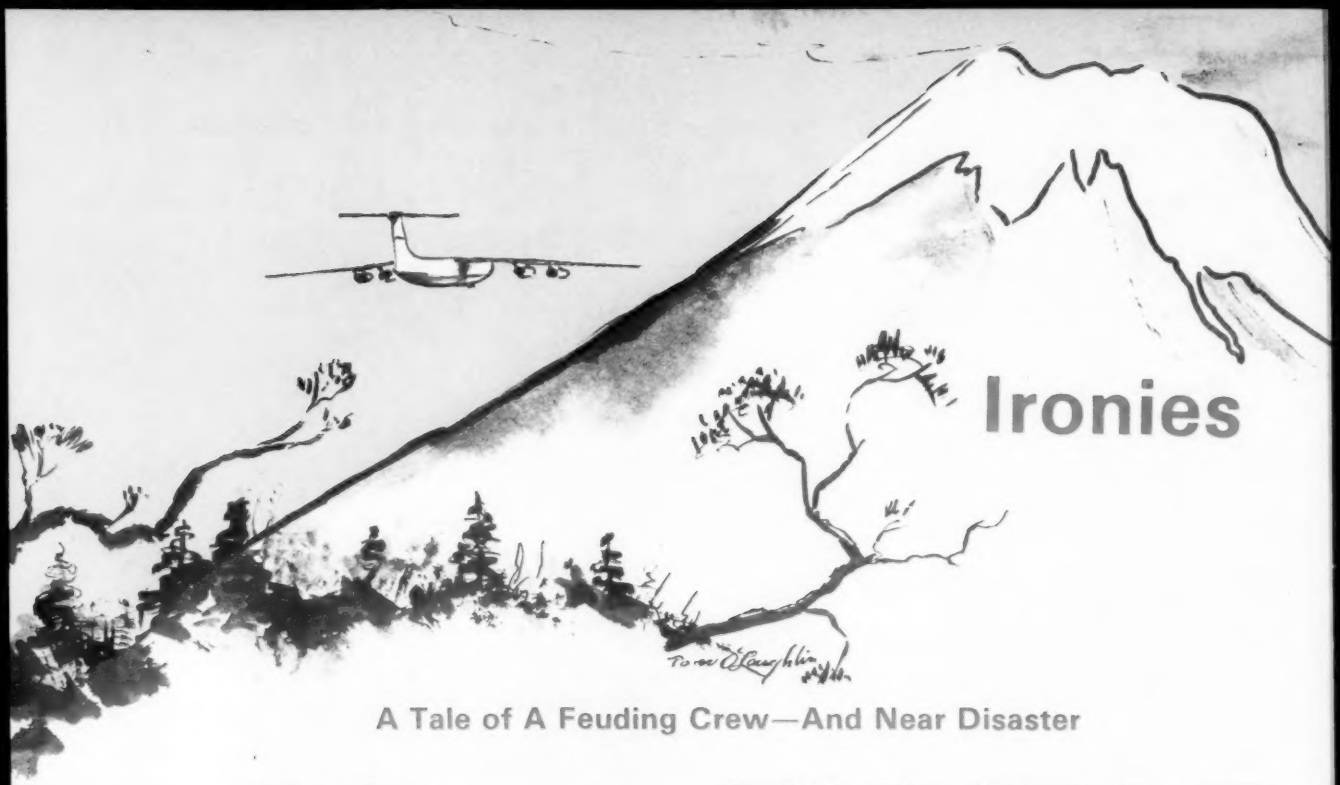
● If there are some special conditions—equipment failure, high terrain, unusual approaches, etc.—cover these, too. And in detail. Again, leave room for questions. Encourage them.

● Put additional responsibility on your crew, if you need to. Don't take it all on your shoulders. Have realistic expectations of what your crew *can* or can't do, and don't hesitate to ask for assistance when required. Remember, people like and accept responsibility, especially when they know you trust them.

Flying MAC aircraft is a team effort, and it can't be done safely without the complete cooperation of the entire crew. ✯

Global Notes

As you may have noticed, the staff of *TMF* has been short one associate editor for about six months. Not so anymore! Capt. Thomas J. Whitmire joins the staff of *The MAC Flyer* with this issue, coming to *TMF* from Little Rock AFB, Arkansas. Well experienced in the tactical airlift business, Thom came into the Air Force via ROTC at the University of Georgia where he was a broadcast journalism major. After UPT at Reese AFB, Texas, he started his military flying career in AC-130s at Hurlburt Field, Florida. Two years later, he transitioned to tactical airlift and flew C-130s at Yokota AB, Japan. After that, he was assigned to Little Rock, where he flew as both an instructor and stan-eval pilot with the 16 TATS. We at *TMF* warmly welcome Thom and his family to Scott AFB and the MAC Directorate of Safety. ✯



Ironies

A Tale of A Feuding Crew—And Near Disaster

by Maj. Bud Baker
United States Air Force Academy
Colorado Springs, Colorado

Ironies....It's been more than ten years since I left MAC, but I still think of Bill now and again. And today, on the "Flying Hour Milestones" page of *The MAC Flyer*, in the same issue that announced a contest for flying safety articles, I saw his name. Bill's 5,000 flying hours are indeed quite an achievement. But I doubt he ever knew how close he came to having a far, far shorter career. I do, though, and I remember still, because only I knew how near we both came to dying one snowy night in Japan...

We were both lieutenants then, flying C-141s out of McChord. Bill wasn't exactly an "old head," but he was one of the squadron's best, a brand-new aircraft commander who had upgraded in minimum time. I was even newer, a greener-than-grass second lieutenant navigator. We met for the first time at ACP. It was Bill's "buddy ride," his first trip as an aircraft commander into the MAC system chaperoned by a more experienced AC in the right seat. I had been checked out on my previous trip and this was to be my first mission on my own, with neither instructor nor evaluator looking over my shoulder.

I remember clearly the panic I felt as the controller gave us our destination: direct Wake Island. There must be some mistake! Didn't they know this was my first trip? We were looking at 10 hours worth of water out there! But my flight suit was loose enough to hide my shaking knees, and I could see no advantage to be gained by sharing my fears with the rest of the crew. I gulped a few times and started checking the fuel figures.

Nearly eight hours out of McChord, Bill, the other AC in the right seat, and I were all watching the TACAN and VOR needles spin. The pilots were getting concerned. Shouldn't the radios be picking up Midway Island about now? With some fast calculating and faster praying, I guessed the DME would lock on soon.

"One minute," I offered bravely. Then I waited. Exactly 60 seconds later, the needles

Third Place Winner, 1984 MAC Flying Safety Writing Contest

pointed straight ahead and DME locked on at 195. I sat back, waiting for the "attaboy" I knew would follow. The pilots just grunted. What was the matter with these guys? I had just dazzled them with a navigational feat worthy of Magellan or Charles Lindberg, right on target after 4,000 miles over the dark and trackless ocean! And on my very first try! And they just sat there acting like it was, well, *routine*.

An hour out of Wake, Bill began to plan the descent. In my innocent, second lieutenant enthusiasm, I volunteered the observation that Wake Island had *two* minimums, one if a ship was in the harbor, the other if the harbor was empty. The pilots looked at each other, trading rolled eyes and disgusted "so what else is new, rookie?" looks.

This was a new ballgame. Bad enough that they didn't appreciate my superior powers of navigation, but now my earnest contributions to our joint health and well-being weren't welcome, either. And this was only the beginning. Over the next few days, a real pattern emerged. I would ask a question, and the pilots would develop pained "see what they're turning out of Mather these days" looks. My observations and comments were treated as trite and obvious, and any mistake (heaven forbid) was met with responses ranging from snide smirks to roaring laughter.

Faced with all this, I decided to do the mature, adult thing: I sulked! The trip was downhill from there. To say that the relationship between us was cool would be a classic understatement. We didn't socialize, and no longer communicated in complete sentences. Statements were acknowledged by nods; simple questions were answered with grunts; more complex queries earned one word, preferably one-syllable, responses.

After two weeks of such fun and games, we were all ready for home. The mission ahead was a long one. From Clark we would shuttle around Vietnam and Thailand, then head up to Yokota. The weather in Japan was lousy—blizzard conditions were forecast for the Tokyo area—but from there at least we could expect to be going home.

The mission itself was pretty standard. Fifteen hours after we left Clark, Bill briefed the descent into Yokota. All was normal until we leveled off at 6,000 feet. It was then that approach control told us that a snowplow had broken down on the runway, and we could expect a 30-minute delay. In the meantime, the holding pattern was saturated, so we would be receiving radar vectors while they tried to clear the runway.

At the end of a long day, after a half hour of radar vectors in the dark, one's attention wanders. The engineers were figuring out per diem, while the pilots discussed the chicken-and-walnuts awaiting them in what was then an all-night o'club stag bar. I was copying the vectors, but was more concerned with my radar scope which had just started to act up. I found I was beginning to pay more attention to the radar than anything else. Among this scope's more endearing qualities, it didn't laugh when I made a mistake, and silly questions didn't seem to bother it.

We'd been on a northerly heading for seven or eight minutes, and my radar was getting sicker. I adjusted the tilt, adjusted the gain; nothing mattered. There was a blank spot in the upper left quadrant, and nothing I did would make it go away. We'd been heading north a long time. Hadn't the controller advised us to expect a right turn in three minutes? I knew it had been longer than that. I could have asked. But then there would have been more rolled eyes, more rookie jokes. No! Besides, these guys were the best in the squadron. We may not

... I decided to do the mature, adult thing: I sulked!

have been best of buddies on this trip, but I had no doubt about their abilities as pilots. I went back to minister to my ailing radar; the blank space was still there, but bigger, maybe....

Suddenly the right-seater seemed to start.

"Hey, nav. Where's the mountain?" His voice had a funny edge to it.

"Mountain?" I came back cleverly.

"Damn right, mountain! Twelve thousand feet worth. Where is it???" His voice now had a very definite sense of urgency.

With my trusty plotter and divider, I quickly figured a TACAN fix. Disbelieving, I plotted it again. If this was right, the peak of Mt. Fuji was two miles northwest. *Which put us over its eastern slope. At 6,000 feet.*

Now I began to see the radar problem with terrible clarity. The radar wasn't failing; it was working fine, simply doing its best to see right through the massive volcano now looming 6,000 feet above us. The result was, of course, the blank spot now covering about half the screen in a wide arc from the eleven to seven o'clock position.

At this point I could say that I instantaneously grasped the situation, and saved the day—however belatedly—by directing an immediate right turn away from the unseen mountain waiting for us out there in the dark. I guess I *could* say it, but it wouldn't be true. Instead, I gaped at the scope, and finally managed to stammer, "Uh, shouldn't we be turning right sometime soon?"

It must have been telepathy. As I spoke, the Yokota controller interrupted. "MAC 40677, immediate right turn, heading 090, expect vectors to an ILS, runway 36." We banked steeply, and for what seemed like the first time in several minutes, I was able to breathe.

Ironies! I can't explain why the pilots didn't notice the strange returns on their radar scope, but I'm certain they never knew how close we came to strewing ourselves across the snowy slopes of Mt. Fuji. But I *did* know, and the memory has always stayed with me.

About a year after I left MAC, another aircrew encountered a mountain. That crew wasn't as lucky as we had been. On that day, MAC lost an aircrew and aircraft, and I lost a number of friends. The pilots were both young, sharp aircraft commanders, and one was on his buddy ride. Most chilling of all to me, the navigator was a new second lieutenant. I never knew that lieutenant, but I've often thought about him since.

There are lessons here for all of us: about the need to be assertive despite inexperience, about the care and feeding of our fellow crewmembers, about motivation, morale, and communication. I can't blame the pilots for my pouting, near-fatal silence. Had I been more confident, less in awe of those two worldly aviators up front, the problem would never have arisen. Besides, blame assessment is rather a pointless exercise. The fact remains that, due to a crew breakdown, MAC nearly lost eight crewmembers and an aircraft that night. How could the situation have been averted?

We've all heard the platitudes, "there are no dumb questions," or "the only bad question is the one that goes unasked." But do we really support those ideas? When the new copilot fouls up a radio call, or when the 19 year-old loadmaster's Form F can't be read through the erasures, how do you react? When the new nav asks about the difference between a flap and an elevator, what do you do? As an "old head" and as a leader, you have tremendous influence over the young people in your care. You can encourage them, build their confidence and self esteem and keep their questions and ideas coming forth. Or you can—subtly or overtly—put your people down, stifling their observations, their ideas, and their confidence.

They say that the problem with the school of experience is that it charges such a terribly high tuition. I was lucky.

Finally, to Bill: Congratulations on your 5,000 hours—I'll look for you on the 10,000 hour list in a few years.

ABOUT THE AUTHOR

Following a tour as a C-141 navigator at McChord AFB, Washington, Maj. Bud Baker was assigned to Grand Forks AFB, North Dakota in 1974. While there he served in numerous positions, including Minuteman instructor/evaluator, crew commander and staff officer. In 1978 he joined the staff of SAC's 15th Air Force headquarters at March AFB California, where he remained until 1982. Major Baker is currently Assistant Professor of Management at the United States Air Force Academy.

Flying-Hour Milestones

Col William I. Hornbostel, 322ALD
Lt Col Gerald F. Hoff, 75 MAS
Lt Col Louis J. Tobin, 75 MAS
Lt Col Floyd W. Weaver, 75 MAS
Maj Donald B. Diehl, 3 MAS

Col Robert I. Grable, 75 MAS
Col Charles Nesejt, 75 MAS
Lt Col Ronald E. Burks, 75 MAS
Lt Col Willie L. Farrow, 3 MAS
Lt Col Leon E. Hess, 1 SOS/CC
Lt Col Robert H. Robben, 75 MAS
Maj David B. Anderson, 702 MAS
Maj James W. Bennett, 41 MAS
Maj Keith A. Johnson, 75 MAS
Maj James K. Moran, 702 MAS
Maj Donald Tzareff, 86 MAS
Maj Ellis V. Smith, 75 MAS
Maj Robert L. Wallick, 1 SOS
Capt Kelly C. Curtis, 702 MAS
Capt Stephen A. Fleming, 1 SOS
Capt Roderick O. Rime, 75 MAS
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TSgt Howard E. Kendrick, 14 MAS
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TSgt Lyle E. Wolfs, 1 SOS
SSgt Eric J. Gschwandtner, 86 MAS

Lt Col Walter S. Hogle, Jr., 1551 FTS
MSgt David C. Smith, 1551 FTS
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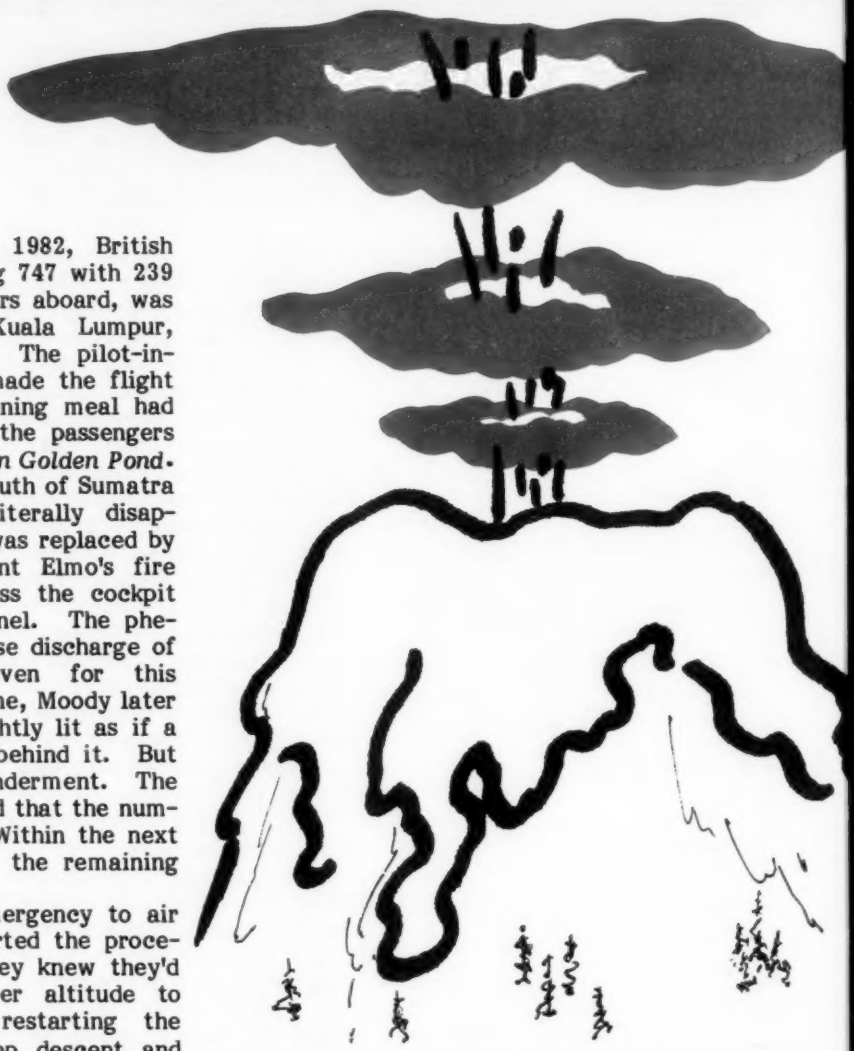
Ranks and units are those at time of award. See MACR 900-3 for details on how to apply for your own milestone award.

High Altitude Volcanic Ash Clouds



On the night of 23 June 1982, British Airways Flight 9, a Boeing 747 with 239 passengers and 16 crewmembers aboard, was on a routine flight from Kuala Lumpur, Malaya, to Perth, Australia. The pilot-in-command, Eric Moody, had made the flight many times before. The evening meal had just been cleared away and the passengers were settling back to watch *On Golden Pond*. Suddenly, passing 100 miles south of Sumatra at 37,000 feet, the stars literally disappeared. The outer darkness was replaced by a spectacular display of Saint Elmo's fire around the engines and across the cockpit windshield and instrument panel. The phenomenon, caused by an intense discharge of electricity, was unusual even for this experienced crew. Each engine, Moody later reported, appeared to be brightly lit as if a spotlight were shining from behind it. But there was little time for wonderment. The first officer quickly announced that the number four engine had failed. Within the next minute, the crew shut down the remaining three engines.

Declaring an in-flight emergency to air traffic control, the crew started the procedures for engine failure. They knew they'd have to descend to a lower altitude to increase the chances of restarting the engines. They began a steep descent and while cross-checking their instruments, the crew realized the two airspeed indicators differed by *50 knots*. Despite the inaccuracy of the airspeed indicators and other instruments, the crew repeatedly attempted to restart the failed engines. Meanwhile, a thick, choking fine dust and a sulfurous odor permeated both the cockpit and the cabin. The usual engine hum was replaced by silence.

The general confusion was compounded when the cabin pressure, no longer maintained by the engines, fell and the oxygen masks dropped from the overhead storage bins. Although catastrophe must have appeared imminent to many passengers, most behaved calmly.

Finally, after more than five minutes, Captain Moody announced to the numbed passengers in characteristically understated British style, "This is your captain speaking. We have a small problem. All of our engines have stopped, but we're doing our damndest to get them working again. I trust you're not in too much distress." The captain's reassurance belied his own concerns, however, as he

began to assess his options: Ditching in the open ocean if he couldn't restart the engines, or making an emergency landing at Jakarta, *if* he could restart them.

At last, after some 13 minutes, the crew finally restarted number four engine. Within a short time, the other engines were also restarted. But the ordeal wasn't over, yet. The aircraft was now below 13,000 feet. The Jakarta airport, about 75 to 100 nautical miles away, was beyond a wall of towering mountain peaks. To facilitate radar pickup, Jakarta control directed the aircraft to climb to 15,000 feet. The captain complied. Soon, though, the Saint Elmo's fire resumed and number two engine failed again. Nursing the remaining three engines and using on-board radar, the crew carefully maneuvered their aircraft around and between the high mountains, and began their letdown into Jakarta. As they descended, the crew noticed that although it was nighttime, they couldn't see any lights on the ground. In fact, they couldn't see anything at all —*the cockpit windshield was completely opaque!* With no visibility and asymmetrical thrust due to the failed engine, the landing at Jakarta required all their skill and resources. But even with seemingly everything working against them, the crew managed to land their crippled 747 safely.

What Captain Moody didn't know was that Mount Galunggung, a volcano on Java, had erupted a few hours before his takeoff, spewing tons of volcanic ash into the upper atmosphere only miles upwind of his flight path. It was the intake of that material by the plane's engines that had caused the trouble. When the number two engine failed for the second time after climbing to 15,000 feet, the aircraft had evidently reentered the ash cloud. And it was volcanic ash that had "sandblasted" the cockpit windshield, making it opaque in only a minute.

After the near tragedy, engineers from Rolls-Royce, the engine manufacturers, and Boeing began an intensive investigation to determine just what had caused the engine failures. The question was puzzling since similar turbojet engines have a long and successful history of desert operations where high levels of dust in the atmosphere are commonplace. Indeed, in Kuwait, an area of frequent airline operations, fine-grained dust layering is said to exist up to 15,000 feet. The usual experience is that such dust causes slow erosion of the engine's compressor

"This is your captain speaking. We have a small problem. All of our engines have stopped, but we're doing our damndest to get them working again."

blades, but no case of engine failure had yet been documented for similar engines.

The Rolls-Royce technicians completely disassembled the engines, boroscoped all the parts, and subjected each and every part to an exhaustive array of tests. Then they ran sophisticated computer models of engine performance in an attempt to simulate the information obtained from the flight data recorder.

Within a matter of weeks, the team of engineers and scientists investigating the incident believed they had found their answer. The most obvious result of flying through the volcanic ash cloud appeared to be the accumulation of melted, ceramic-like deposits on the surfaces of the turbine, the hottest part of the engine. The deposits were so thick in places that the overall turbine area through which the air needed to pass was reduced by *more than 10 percent*. This, in turn, reduced the overall engine airflow by roughly 10 percent. Although that reduction

The cockpit windshield was completely opaque!

may seem minor, the consequences are catastrophic for engines as finely tuned for maximum efficiency as turbofans. As the airflow was reduced by the blockage, the pressure built up by the compressor rose. Soon, the pressure reached the maximum physically attainable at the specific rotational speed of the compressor, resulting in a compressor stall.

In retrospect, the compressor stall caused by the intake of volcanic ash should not be too surprising. The effluents from large volcanic eruptions have been intensively studied for decades. Of interest here are the pyroclastic volcanic materials (literally, fire-broken rocks).

There are basically two kinds of pyroclastic materials—glassy and crystalline. Glassy materials result when a volcano's magma, or molten rock, undergoes a sudden cooling and the atoms of material making up the magma are frozen in the positions they happen to be in at the time. The result is an amorphous disordered structure. Crystalline pyroclastic materials, on the other hand, are created when, over geologic time, the atoms of the volcanic material slowly form intricate lattice structures and geometries.

Of crucial importance to the engine problem are the melting temperatures of these materials. Glasses have a characteristic melting point of between 600° to 800°C. In order to melt crystalline materials, however, additional energy is required to overcome the internal forces that result from their lattice structure and interatomic bonding. Crystals melt in the range of 1,100° to 1,200°C. Sand in many desert areas characteristically melts within the same temperature range as crystalline pyroclastic materials.

The operating temperature of a typical jet engine at the turbine inlet area is about 1,000°C. Thus, one might expect that turbojet engines could tolerate ambient desert sand, dust and volcanic crystalline ash with little risk these particles would form deposits. On the other hand, volcanic ash clouds that are enriched with glassy materials may be more hazardous. By all indications, the melting points of glassy volcanic materials are low enough so that even during the short time these materials might spend in the hot turbine section, they can melt. Additionally, the molten deposit can potentially form a surface to which unmelted particles may adhere as well.

The inevitable question arose: What can be done to avoid the problem? A partial answer came about three weeks after the British Airways incident.

On the night of 13 July 1982, a Singapore Airlines 747 with 230 passengers aboard was on a flight from Singapore to Melbourne, in the same vicinity as the British Airways flight, when it experienced a similar sequence of events. At about 9:30 P.M., cruising at 33,000 feet, the crew noticed the appearance of Saint Elmo's fire around the four Pratt & Whitney engines. This was followed by erratic behavior in number-one engine. The pilot, Nicholas Evans, correctly guessed he had penetrated a volcanic ash cloud. He immediately reduced power to idle on the troubled engine. As he began to bring number one back to its fully operational condition, the number two engine showed signs of trouble. Shutting down this second engine, Evans elected to return to Singapore. While descending to 26,000 feet, however, numbers three and four also had to be shut

down to avoid overheating. With only one engine operational, the crew worked to restart the other engines. Finally, only the number three engine started. At 13,000 feet, the crew realized that with only two engines in operation, Singapore was too far away to reach. Not knowing the position of the suspected ash cloud, the crew decided that an emergency landing at Jakarta was their only option. They declared an in-flight emergency and dumped 13,000 pounds of fuel to lighten the load. Even though the aircraft was operating on only two engines, it reached Jakarta and landed safely. Significantly, of the two operational engines, one had been preserved by the initial action to reduce power. A reduction in power results in a reduction in temperature, and since it is high temperatures that cause the material to melt, reducing power may be one way of avoiding excessive particle buildup.

Outside the United States, there are more than 120 potentially active volcanoes that can't be monitored practically.

Pratt & Whitney and Boeing engineers investigated the Singapore Airlines flight and their conclusion was consistent in all respects with that of the investigation of the British Airways encounter. The buildup of foreign material inside the engines had reduced the airflow by roughly 10 percent and caused compressor stall.

Pilots and aviation officials are now considering what can be done to better detect and avoid volcanic ash clouds. Outside the United States, there are more than 120 potentially active volcanoes that can't be monitored practically. In addition, some of the most violent volcanic eruptions, like the April 1982 eruption of El Chichon in Mexico, occur at locations with little previous history to justify surveillance.

Some of the world's most heavily traveled air routes are the Great Circle routes across the North Pacific from the United States to Japan. Many of these flights pass over a portion of what is known as the Ring of Fire, a rough circle of active volcanoes that stretches from the Andes in South America up the North American coast, to the Aleutian Islands, across the Bering Sea to the Kamchatka Peninsula, and down to Japan and Indonesia. The most explosive type of volcanoes are found here in at least two respects. Their magma is highly viscous and they release their trapped gas in a violent fashion. During the past five years, more than 20 significant volcanic events have occurred beneath the North Pacific air routes alone.

Currently the most feasible strategy for tracking volcanic ash clouds is the use of existing meteorological and environmental satellites. A problem nearly equal to that of detection is how to determine, on the basis of satellite information, when it is safe to terminate airspace restrictions. Given the magnitude of the airspace potentially affected following large eruptions, this question is of enormous economic importance. Solving it depends on knowing what densities of volcanic ash pose a problem for turbojet engines.

Despite the advantages of satellite technology, it is unlikely that such systems can be used for the initial detection of many volcanic eruptions until their clouds are sufficiently well developed to be recognizable. But this may be too late to provide information at the most crucial early times. For that, there may be no substitute for reliable, firsthand human observation, combined with rapid international communications—something unlikely to be forthcoming in many sparsely populated areas of the world.

Pilots who fly regular schedules over historically active volcano sites are often the first to note the smoke, gas plumes and other signs of an impending eruption. The eruptions of Mount St. Helens, for example, have in most cases been reported initially by airborne pilots and communicated by them to air traffic control personnel.

Many problems remain, but government agencies working in concert with several universities are attacking the problem. There are no immediate solutions on the horizon, but one day there will be a safe way to predict and avoid high altitude volcanic ash clouds.

Adapted from Cathay Pacific—*Kai Talk*, and *Flight Safety Focus*

Real Pilots Don't Eat Parsley

How To Tell A *Real Pilot* From A *Wimp*!

by Maj. Bruce L. Gumble, USAF (Ret)
Vacaville, California

I was sitting in the cafeteria at Yokota, working on a chili cheeseburger and watching Worthington-Smythe picking at a chef's salad, when the idea finally hit me. It had been sort of buzzing around the edge of my mind ever since last night when Tex McArdle and I were talking about the good old days and whatever happened to fun flying.

"It's the wimps," Tex said. "The whole command is full of wimps. You know, the kind that's scared to fly hung over, and turn you in to stan-eval if you go over 30 degrees bank turnin' final. Some of 'em are so wimpy tnat if you even talk about doin' an aileron roll or flyin' down initial at 350 indicated, they'll faint dead away. It's just like the quiche-eaters in that *Real Man* book. If we could just find some way to tell the wimps from the real pilots like you 'n me, we could get some good old-fashioned flyin' done without havin' to look over our shoulders all the time."

I had to allow that Tex was right, but couldn't figure a way to do the job. So we

Special Category Winner, 1984 MAC Flying Safety Writing Contest

just cleared the area for flight examiners and known wimps, and kept rolling the dice.

Anyway, I was thinking about that conversation while I watched Worthington-Smythe. Now, there was an absolute "classic" wimp. The hyphenated name was bad enough, but there were worse things about old W-S. Like ratting on an AC and engineer for "saving up" a flight control malfunction for a couple of legs and then going NORS in Bangkok. So maybe there really was a problem, and maybe the crew did get shaken up a little bit during the approach, but so what? No *real* pilot would miss a crew rest in Bangkok on account of something like that. Or that time down in Sydney when the extra loadmaster decided to stay in town while the crew made the shuttle to Alice Springs and back. No big deal, but old W-S blew the whistle on 'em. Forever preaching about safety and regulations, too. It was a sure thing that with Worthington-Smythe on your crew, you could forget about having any fun.

I was thinking about that while I watched the wimp go through that salad. Salad, yet, as though real food wasn't good enough. Even ate the parsley. I grinned to myself. Everybody knows that *nobody* eats parsley.

Then the thought hit me. Of course somebody eats parsley—*wimps* eat parsley! I thought of all the wimps I knew and sure enough, every one was the type that would eat parsley. Or soup and salad, for that matter. Then I thought of all the real pilots I knew and none of them—*not a single one*—would have eaten parsley if you pointed a gun at 'em!

This was what Tex and I had been looking for. I scarfed down the last of my cheeseburger, washed it down with the rest of my chocolate shake, and headed back to base ops so I could write down the idea right away. I tore a sheet of NOTAMS off the wall—who cares about New Guinea, anyway—and wrote in big letters on the back:

REAL PILOTS DON'T EAT PARSLEY!

That was how it started. By the time we got back from that trip, I had a list of stuff anybody could use to tell a real pilot from a wimp at 30 meters in a Shemya fog. It wasn't just a matter of food, of course, but watching what a pilot eats is one of the best ways. I even interviewed a half dozen real pilots, and they all agreed on the basic stuff that we don't eat and the stuff we do (see the following).

THINGS REAL PILOTS DON'T EAT

Breakfast
Parsley
Yogurt
Vegetables (except beans)
Anything with a nutrition information label
Box lunches less than eight hours old
Quiche

REAL PILOT FOOD

Cheeseburgers
Chili
Chili cheeseburgers
French fries
Preservatives
Anything you can buy from a machine
Anything that comes in a cellophane bag
Salt

When you're looking for wimps, be sure to notice breakfast-eating habits, especially on locals. Anybody who shows up for an 0600 local with oatmeal on his or her breath is a certified wimp. Real pilots know that you can get at least five hours of local flying out of a cup of coffee and a cigarette. A glass of OJ is permissible if the pilot in question has a hangover, but anything else indicates high wimp potential.

One more note on locals. After three hours of ramp-pounding, real pilots will reinforce themselves with roach-coach chili or a cold cheeseburger. Wimps usually keep granola bars in their helmet bags and wash them down with (yecch!) water. Bringing a lunch in a brown bag is, of course, *absolute* proof of wimpdom.

What a pilot drinks can also be a dead giveaway. Real pilots, of course, can't even *spell* Perrier (I had to look that up), let alone *drink* it. Wimps thrive on the stuff. Real pilots like gin, milkshakes, vodka, coffee, bourbon, Scotch, beer, tequila, rum, and other basic subsistence drinks. Wimps drink iced tea, milk, water, diet soda, apple juice, and (when they can work up their nerve) Brandy Alexanders.

Now, I don't want anybody to get the idea that real pilots are just out to have a good time, or that we're some kind of idiot daredevils that sneer at fate and like that. Of course, we don't mind having a good time when one comes along, but we take the flying business seriously. We know what's important when it comes to getting the job done, and we know that there are some things you really have to watch out for. In fact, Tex

and I took a pretty extensive survey to find out what real pilots are scared of. Here's what we came up with:

THINGS THAT SCARE REAL PILOTS

Wing commanders
Crew delays
Not getting home for special occasions
Acquiring a "no-go" reputation
Missing Happy Hour

THINGS THAT DON'T

Safety officers
Pilot error
Murphy's Law
Thunderstorms
Waivers
Crew duty day extensions
Dying

A lot of wimps, of course, don't see it quite the same way, but that's what makes them wimps. Another way to spot wimps is to watch what they do when something goes wrong. I mean, a real wimp will go back into crew rest at the drop of an ETIC, when a real pilot will gut it out. Wimps turn down missions for bad weather, broken airplanes, and dumb kid stuff like that. But real pilots? Check out this part of our survey.

CONDITIONS WHICH CAUSE REAL PILOTS TO REFUSE A MISSION

That's what I mean. Real pilots are go-oriented. Of course, it's possible to turn down a mission if you know beyond a shadow of a doubt that there's absolutely nothing going on at the other end, but that hardly ever happens. You can usually scratch up some action anyplace, anytime.

Well, that's about it. By now, you ought to be able to pick out the wimps in your outfit and steer clear of them. If you're still having trouble, here are a few examples to go by:

SOME REAL PILOTS

C.R. Terror
Snoopy
Wiley Post
Wrong-Way Corrigan
The Red Baron
Darth Vader

SOME PARSLEY-EATING WIMPS

The astronauts
Long-suffering Sam
People who write flying safety stories

Oh, yeah, one more thing. Try to keep old Worthington-Smythe from seeing this. Now that she's a flight examiner, she's even wimpier than she was before.

Good luck, ol' buddy, and fly happy.

ABOUT THE AUTHOR

While on active duty, Major Gumble survived enough missions in the C-141, CT-39, and QU-22B to qualify for his 5,000-hour patch, after which he decided to quit pressing his luck. He also claims to have over 3.2 million hours as a simulator instructor and flight examiner, and is credited with coining the phrase "Simulater Pilots Only Pretend to Do It." For a short time he served as an Associate Editor of *The MAC Flyer*, an experience from which his analyst says he has never completely recovered. Major Grumble is now living in Upper California with a balky word processor and an itinerant tomcat named Murphy. When he hears a Lockheed Legend droning overhead on a weekend or midnight local, he smiles.

TMF Instrument Quiz

Congratulations! You and your trusty crew have been selected to fly a SAAM to Hong Kong, complete with a 48-hour crew rest there. After determining that, yes, you can operate into Hong Kong International safely and legally, you pull out a copy of Volume 2 of the *High and Low Altitude Pacific, Australasia and Antarctica* FLIP book. Consider you have all the necessary equipment to fly the approach depicted below.

1. Reference the *IGS RWY 13 "MK" or "CH" VOR FEED IN* approach plate. What does "IGS" stand for?
   a. Inertial Ground Speed.
   b. Instrumented Glide Slope.
   c. Instrument Guidance System.
   d. International Guidance System.

2. The minimum safe altitude of _____ is effective within _____ of _____.
   a. 6,600 meters/ 100 nm/ RW NDB
   b. 4,500 feet/ 25 nm/ RW NDB
   c. 6,600 feet/ 25 nm/ OM
   d. 4,500 feet/ 25 nm/ OM

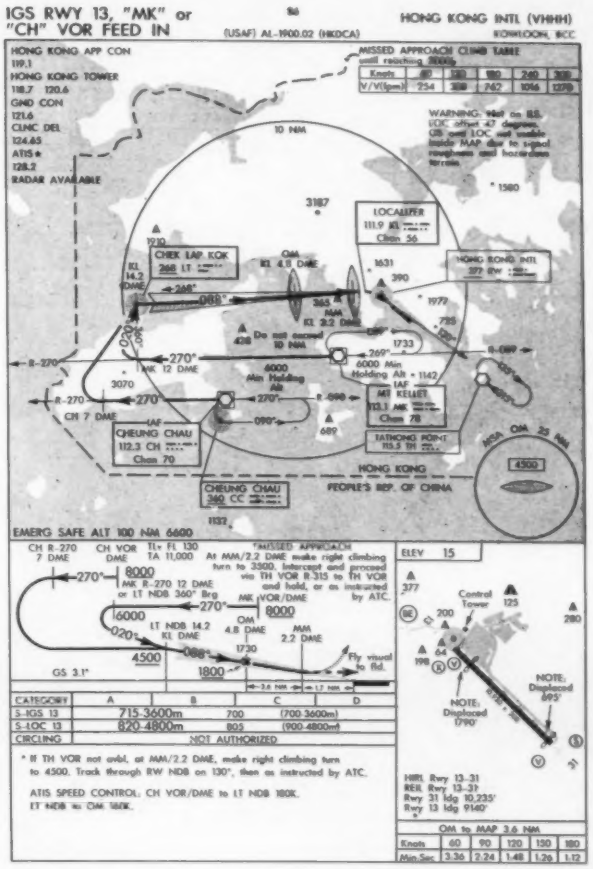
3. DME is required to fly this approach.
   a. True
   b. False

4. The transition level is _____.
   a. FL 180
   b. 13,000 feet MSL
   c. FL 130
   d. 11,000 feet MSL

5. You're cleared for the localizer approach as you reach CH VOR. What airspeed should you hold enroute to LT NDB?
   a. The minimum speed specified by your Dash-One.
   b. Approach speed plus 20 knots.
   c. 180 knots.
   d. The minimum speed specified by your Dash-One or 180 knots, whichever is greater.

6. The ATIS operates continuously.
   a. True
   b. False

7. The MDA and visibility for the straight-in localizer approach to RWY 13 are _____ and _____ for a Category C aircraft.
   a. 820 meters/ 4,800 feet
   b. 700 feet/ 3,600 meters
   c. 820 feet/ 4,800 meters
   d. 715 meters/ 3,600 feet


IGS RWY 13, "MK" or "CH" VOR FEED IN
HONG KONG INTL (VHHH)
(USAF) AL-1900.02 (HKDCA)
HONG KONG APP CON
HONG KONG TOWER
GND CON
CLNC DEL
ATIS
RADAR AVAILABLE
MISSED APPROACH CLIMB TABLE
LOCALIZER
CHEK LAP KOK
HONG KONG INTL
CHEUNG CHAU
TATHONG POINT
HONG KONG
PEOPLE'S REP. OF CHINA
EMERG SAFE ALT 100 NM 6600
*MISSED APPROACH
ELEV 15
Control Tower
NOTE: Displaced 695'
NOTE: Displaced 1790'
HIRL Rwy 13-31
REIL Rwy 13-31
Rwy 31 ldg 10,235'
Rwy 13 ldg 9140'
OM to MAP 3.6 NM
CATEGORY A B C D
S-IGS 13 715-3600m 700 (700-3600m)
S-LOC 13 820-4800m 805 (900-4800m)
CIRCLING NOT AUTHORIZED
* If TH VOR not avbl, at MM/2.2 DME, make right climbing turn to 4500. Track through RW NDB on 130°, then as instructed by ATC.
ATIS SPEED CONTROL: CH VOR/DME to LT NDB 180K.
LT NDB to OM 180K.

8. You're on final approach at the middle marker and established on the localizer (on course, of course). How many degrees will the runway heading be offset from your heading, and to which side should you look to see the runway?

a. 47°/ right
b. 27°/ left
c. 47°/ left
d. 27°/ right

9. You're at the middle marker and the runway is not in sight. Assume the TH VOR is inoperative. What should you do?

a. At the MM/2.2 DME make a right climbing turn to 3,500 feet. Intercept and proceed via the TH VOR R-315 to TH, then hold.
b. Climb to 3,500 feet and proceed directly to MT VOR for holding.
c. At the MM/2.2 DME make a right climbing turn to 4,500 feet. Track through the RW NDB on 130°, then as instructed by ATC.
d. Contact the tower and request a circling approach.

10. Assuming your missed approach speed is 240 knots, what minimum vertical velocity should you maintain until passing 2,000 feet?

a. 250 fpm
b. 750 fpm
c. 762 fpm
d. 1016 fpm

11. You finally made it around the pattern again and saw the field at the middle marker. What course guidance should you use to complete the approach. (Assume ceiling and visibility are both above minimums).

a. KL localizer
b. TH VOR
c. RW NDB
d. Proceed visually, the localizer and glide slope are unusable due to signal roughness and hazardous terrain.

12. You're cleared to land on RWY 13. How much of the runway is available for your arrival?

a. 9,140 feet
b. 10, 930 feet
c. 10,235 feet
d. 8,445 feet

The Answers

1. **c.** You get 100 extra points if you answered Instrument Guidance System. This terminology is covered in *Hong Kong Aeronautical Information Publication RAC 4-2-15*. In essence, the IGS has both electronic glide slope and localizer, but it's not an ILS because of the offset from the runway centerline. The warning in the top right of the planview notes this, as does the localizer voice transmission. Incidentally, host nation approaches adapted for DOD products are titled with the exact approach name used by the host.

2. **d.** The MSA and the point from which it's computed are found in the lower right corner of the approach planview.

3. **a.** Portions of this approach can't be flown without DME.

4. **c.** The transition level is given at the top of the approach profile.

5. **d.** See the notes in the lower left hand corner of the approach profile. A broadcast on the ATIS or controller instructions will also inform you when speed control is in effect.

6. **b.** The star beside the ATIS in the upper left hand corner or the approach planview indicates the ATIS operates non-continuously.

7. **c.** Remember, MDAs and DHs are always printed in *feet*. The visibility may be expressed in either *feet or meters*.

8. **a.** See the note at the top right corner of the approach planview.

9. **c.** The information is found in a note in the lower left hand portion of the approach profile.

10. **d.** The figure is obtained from the missed approach climb table, located in the upper right corner of the approach planview.

11. **d.** Completing the approach visually is your only choice, as indicated by the note at the far right side of the approach profile.

12. **a.** The runway available is listed under the airport sketch.

Turboprops Are Quick

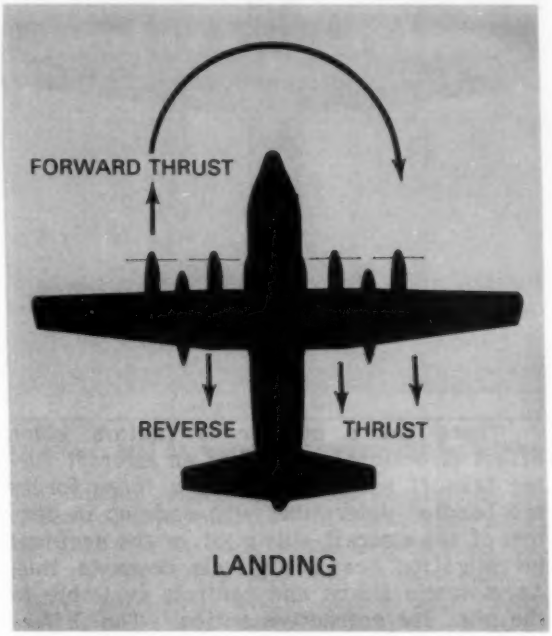
How Would *You* Handle A Directional Control Problem?

(Editors' Note—This article, which originally appeared in the December 1969 *TMF*, is a discussion of the C-130, its powerplants differential control problems on takeoff and landing, and the part that timely recognition plays in keeping the Herk under control if you should encounter these problems. This article isn't intended to be the ultimate word in discussing powerplant/control problems. It *is* intended to stimulate discussion and research into the subject.)

Let's review a couple of case histories. First, here's what happened when a C-130 attempted a takeoff with an outboard propeller apparently in ground operating range (beta) and the other propellers governing normally. In this representative accident, pretakeoff power checks indicated that the number-one engine wasn't developing full power as evidenced by reported high RPM, low torque, TIT, and fuel flow. The crew finally elected to go with what they suspected as "low power output."

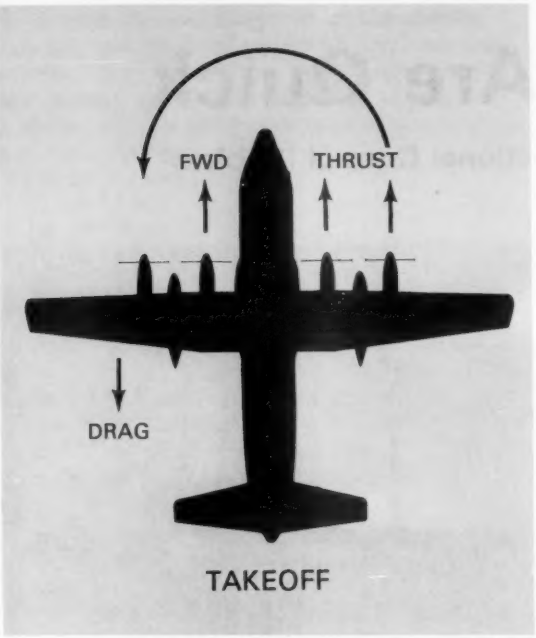
The runway was almost sea level, and 8,300 feet long by 200 feet wide. Approximately 2,000 feet from the start of takeoff roll, the nose gear began skidding left. At this point, the pilot rotated to takeoff attitude. At 3,800 feet, the aircraft departed the runway in a skidding left turn, nose high, left wing low, traveled a short distance on the grass, then became airborne for approximately 150 feet. The aircraft settled back to the ground on the left main landing gear for a distance of approximately 50 feet, then became airborne again for about 1,000 feet. At that time, the left wing struck an obstruction causing it to separate near the number-one engine.

Thrust that gets out from under the pilot's palm can also cause problems on landing. Here's an accident which is typical of one propeller not reversing during landing. The B-model crew was VFR and landing on a



4,225 by 98-foot strip of uneven pierced plank. The crew flew a 4,000-foot pattern and made a short field landing approach with a threshold speed of around 145 KIAS.

Crew and plane touched down about 1,500 feet from the threshold. The aircraft bounced and yawed about 15 degrees to the right while still airborne. When the aircraft hit the ground again, it immediately swerved to the right, leaving the runway nearly 2,000 feet from the threshold. The crew apparently regained control because the aircraft then paralleled the runway 20 feet to the right. The aircraft commander was unable to return to the runway and the aircraft continued on this track until the nose gear dropped into a ditch.



TAKEOFF

There are a number of factors which affect directional control of an aircraft during takeoff and landing. How these forces are handled determines who ends up in control of the aircraft—the pilot, or the accident investigation board. It boils down to this: Asymmetric thrust and controls available to the pilot for corrective action. The difference between these two is available controllability.

Asymmetric thrust is a result of uneven power output from engine and propeller combinations. Normally, there are only slight variations between engines. However, if we have a feathered prop, the asymmetric thrust produced by the opposite operating engine(s) can become quite large. Throw in drag or the thrust of a malfunctioning prop and it's easy for the situation to get out of hand.

Asymmetric thrust results in a turning moment on the aircraft which is the product of the asymmetric thrust and the distance between the aircraft centerline and the thrust line. As an example, take the case of landing and reversing with a pitch-locked propeller. The turning moment acting on the aircraft can be extremely large, since it will be the sum of the moments produced by forward thrust from one propeller and reverse thrust from the others.

The pilot's available controls are throttles, aerodynamic controls, nose wheel steering, and brakes. Since asymmetric thrust is the producer of the adverse turning moments, placing the throttles in a position of least unbalanced thrust is the most effective control. *(Editors' Note*—Remember, the key to dealing with a directional control problem on landing is to *minimize* thrust differential. For instance, what would you do if, during a normal landing and just after you had retarded the throttles from flight idle toward ground idle, the aircraft suddenly veered to the right? Take the same question, but now make it a maximum effort landing. What would you do now? And if a "bog down" occured to you on a normal landing while retarding the throttles below flight idle, what is your safest course of action?)

Rudder effectiveness is a function of speed and rudder boost pressure. At slow speed, the rudder is virtually ineffective. Nose wheel steering capability varies with the amount of weight on the nose gear and the condition of the runway. Brakes may help in maintaining directional control, but braking is a function of runway surface.

Thrust is the end result of the pilot's throttle movements, but what he sees on the C-130 engine instrument panel is indicated torque. During normal takeoff and cruise, the relationship between torquemeter readings and thrust follow a given relationship. Remember, however, that the torquemeter reads positive torque during reversing, and it will indicate positive torque when the powerplant is producing drag and the propeller is actually in reverse. Since torquemeter indications may be misleading in some cases, the flight crew must accurately interpret the engine runups and correctly handle powerplant emergencies during takeoff and landings. TIT, RPM, and fuel flow should be monitored as well as torque. Crosschecking a malfunctioning engine against the other three engines will, in most cases, reveal the problem. *(Editors' Note*—If you should happen to have a prop "hang up" on landing, chances are that the pilots will be the first to recognize it, followed shortly thereafter by the rest of the crew.)

To better understand the magnitude of forces involved in the C-130 power plant, look at the distribution of power through the turbine to the propeller. The propeller on a T56-A-7 engine, for instance, absorbs 4200 horsepower, gearbox and accessories about 100 horsepower, and the compressor uses up a whopping 5500 horsepower. So the turbine must produce 9800 horsepower. Should that engine flame out, the propeller then attempts to drive the power plant at an on-speed RPM when airspeed is sufficient.

To prevent severe asymmetric drag on the aircraft, the negative torque system (NTS) and the safety coupling were incorporated into the power transmission system. The NTS limits negative torque to a nominal minus 1260 inch-pounds, or minus 275 horsepower. Backing up the NTS is the safety coupling, located between the gearbox and the torque shaft, which disconnects the propeller and gearbox from the engine at about minus 6,000 inch-pounds.

Going back to the example of the takeoff accident, let's assume that the propeller was below the low pitch stop with no ability to hold or increase blade angle, say at the minus 4-degree angle. (Fig. 1.) During run-up, the torquemeter would read less than one-third normal takeoff torque, and there would be a slight reverse thrust generated prior to brake release. RPM would be about 105 percent or fuel limiting. As velocity increases down the runway, torque increases and RPM falls off, indicating an *apparently* improving situation. This assumption is *wrong*. Reverse thrust, or drag, will increase as airspeed increases, causing the aircraft to become less and less controllable. High RPM accompanied by low torque should alert the crew to a problem as takeoff power is set.

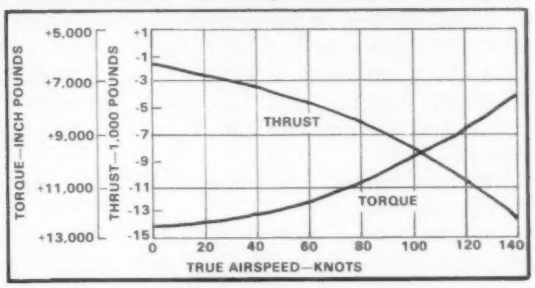


Figure 1. Propeller, Torque and Thrust, -4° Blade Angle and Fuel Governing

Figure 2 reveals what the pilot must cope with in the above takeoff case. Asymmetrical thrust produced by three engines operating at takeoff power (19,600 inch-pounds torque) and the number-one propeller remaining in the ground operating range (beta) is shown by the line so labeled on the chart.

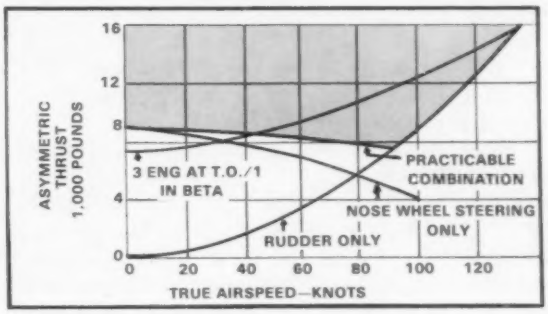


Figure 2. T/O Asymmetric Thrust vs. Controllability

The shaded area at the top represents the uncontrollable range. The light line shows capability with nose wheel steering on the dry runway only, and the bottom line is rudder only. The border of the light shaded area depicts the practicable combination of rudder and nose wheel steering which the pilot is able to attain. In this case, most of the nose wheel steering capability is required to prevent the aircraft from swerving at brake release. As the takeoff roll progresses to 40 or 50 knots, the asymmetric thrust has increased so that it exceeds the available control capability, and the pilot is no longer in command of the aircraft.

Next, let's look at asymmetrical thrust of the typical landing mishap. In this case, number-one propeller remained in the flight range (as an example, pitch-locked at 35 degrees) and the other three propellers fully reversed after touchdown. (Fig. 3.) Notice that the aircraft is uncontrollable at all speeds *below* 120 knots. To recover from this situation, the pilot must return throttles to ground idle to reduce the unbalanced thrust condition. The area on the chart bounded by dashed lines represents rudder effectiveness

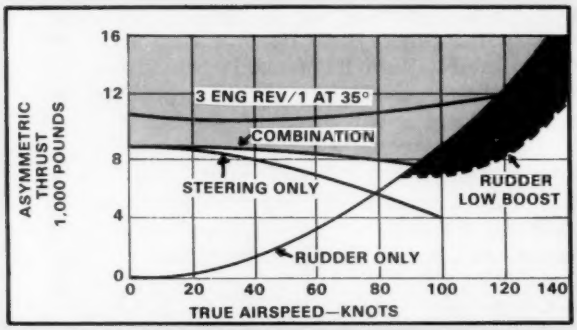


Figure 3. Landing Asymmetric Thrust vs. Controllability

in the rudder low-boost operation with the flap lever above 15 percent, or with the loss of one hydraulic system.

Propeller malfunctions will usually be detected by the crew that performs an engine power check before each takeoff. It should be standard procedure to investigate any unusual differences shown by engine instruments during run-up. If there is any doubt that you have an engine or propeller problem, your best bet to become an "old, bold pilot" is to taxi back and let the maintenance crew investigate. When these emergencies occur during takeoff or landing, there are certain proven steps to follow.

Before Refusal Speed

If a suspected propeller malfunction occurs on the takeoff roll prior to refusal speed:

1. Retard all throttles to flight idle and move the condition lever for the affected engine to feather (C-130 abort procedures).
2. Retard all throttles to ground idle.
3. Use symmetrical reverse and brakes to stop.

After Refusal Speed

If a propeller malfunction occurs after refusal speed, continue the takeoff. If the malfunction was caused by electronic governing, placing the prop governor control switches in mechanical governing will normally correct the problem. If not, check for a pitch-locked propeller as outlined in section III of the Dash-One.

During Flight

A rare malfunction which has occured and requires proper handling during flight, is propeller pitch-lock, or fixed-pitch propeller. There is always the possibility of high drag up to the point of safety-coupling disconnect, or high propeller overspeed after decoupling. Under certain combinations of blade angles and aircraft operating conditions, drag produced by a windmilling propeller coupled to the power section can be about six times higher than decoupled drag. For this reason, the emergency procedures recommend slowing to 150 knots true airspeed before securing the engine. This speed is high enough to generate the necessary negative torque to decouple the propeller, but not high enough to produce an excessive overspeed on the decoupled, windmilling propeller.

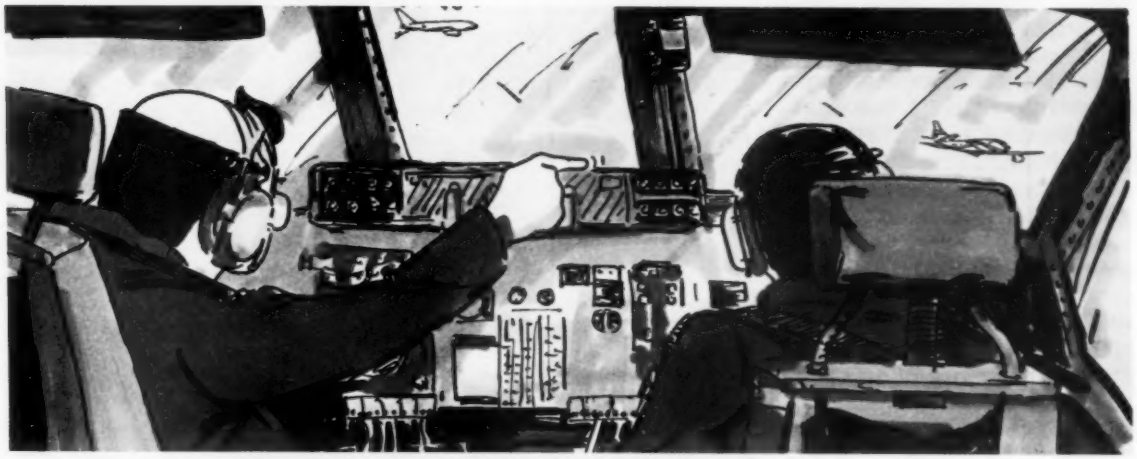
Landing

Landing with a malfunctioning propeller, as one of the accident examples indicated, can present the pilot with a handful of control problems. Placing throttles in full reverse with one propeller remaining in the flight range (as when pitch-locked) presents a completely uncontrollable situation! If the aircraft swerves when throttles are placed in reverse, it should be handled this way:

1. Immediately return throttles to ground idle to reduce asymmetric thrust.
2. Make maximum use of nose wheel steering, rudder and aileron, differential power and differential braking to control the swerve.
3. When control is re-established, apply maximum brakes.
4. If the engine instruments indicate which propeller is malfunctioning, shut down the engine with the condition lever.
5. Use symmetrical reverse to aid stopping.

The C-130's turboprops are always ready. With a little respect and close attention to the engine instruments, the turboprops will remain faithful servants and not become the masters of the aircraft.

C.R. TERROR



The Truculent Titan Terrorizes A Tanker

Thar she blows. Three points off the starboard bow. Ready the harpoons." C.R. Terror, MAC's most recently qualified air refueling AC was undeniably excited. After all, spending eight weeks at Altus in AR class (more correctly, parts of three classes) had taught the Raconteur of Refueling one eternal truth. "One visual sighting of the tanker is worth a thousand times more than the most precise radar fix in the world."

Turning to his already hyperventilating copilot, C.R. continued his non-stop monologue on the art of refueling. "Nothing to it, Sammy m'lad. Now that I've got that sleek airborne gas station in my sights, all I gotta do is pick up about 75 knots of overtake and give chase. No need to slow down early, because once we get close, that boomer up there is gonna scream bloody murder. My technique is foolproof. Wait 'til he screams, count one potato, two potato, three, then pull the power to idle. With any skill at all and providing we've got a boomer with 20/20 vision, we'll coast to a stop in precisely the precontact position."

Sammy was totally unimpressed, especially since he'd been flying AR as a copilot for well over two years. He knew better, the crew knew better, *everybody* knew better. Everybody, that is, except for the Prideful Pilot. Still, the ever-competent copilot had to *try* to get the AR accomplished with some degree of professionalism.

"Uh, Boss, shouldn't we be at FL 250? Our block altitude is 250 to 280 and my altimeter shows us at 243. I really think we ought to climb."

"Nonsense, Sammy," C.R. boomed confidently, eyes fixed on the tri-engined aircraft at their one o'clock position. "I've got a good visual on the tanker and he can't be any more than 300 feet below us. I'll just stay up here and dive down at the last moment. Keeps the old momentum up, ya know. By the way, have you got our new routing to Goose Bay approved yet?

"I'm working on it, Boss, but I sure wish you'd wait 'til the AR's over. There's things I need to do." Sammy's attempt to postpone the

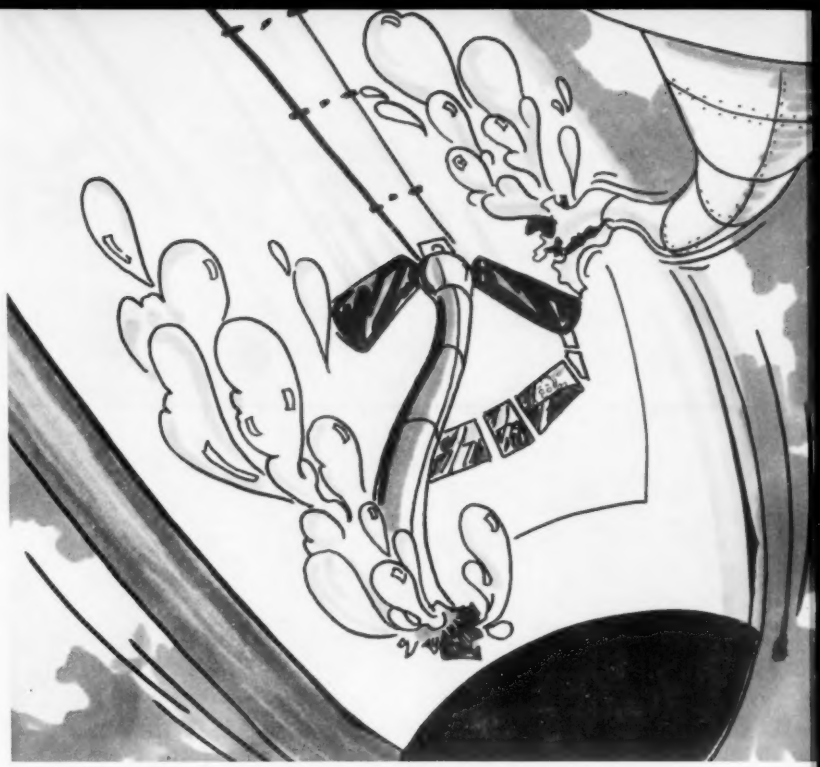
flight plan change was short circuited by Blinky.

"Pilot, nav. I show us at one mile, but keep an eye out. I've got another target at eleven o'clock." Blinky was, as usual, on top of the situation. "By the way, I just confirmed the tanker's altitude with their nav and they swear they're at FL 260. Are you sure you've got them in sight, Boss?" The diminutive nav strained to catch a glimpse of the tanker.

"Blinky, I'm really disappointed in you. How can you doubt my judgment?" C.R. was doing his best to sound offended. "Boy, SAC sure has those KC-10s all painted up purty. Never seen one with red and orange stripes on the tail. Looks a lot like the United emblem..."

"CLIMB!" Sammy and Blinky screamed in unison and needed no interphone to be heard throughout the C-5. "Boss, how *could* you? Not only are we at the wrong altitude, but you're trying to rejoin with a commercial DC-10. And we're not even refueling with a *KC-10*—our tanker is a KC-135! Pull up before we get violated." Both copilot and nav saw their careers going down in flames.

"Crimenently, you two! What ever happened to the crew concept? Sammy, just because I asked you to figure a new routing to Goose Bay is no reason not to monitor the type of airplane I'm trying to nuzzle up to. And you,



Blinky! I thought that radar of yours was so good it could tell you how many engines an aircraft had on each wing, and at a range of 50 miles!" The Addled Aviator continued his Terroriffic Tirade even as he abruptly leveled the Galaxy at FL 260 and less than a half mile behind their amazed 135.

Sammy and Blinky sighed and exchanged exasperated looks. "Our mistake, Boss," they muttered, then lapsed into sullen silence.

"Enough whining, crew," chastised the Master Manipulator. "Let's get the checklists completed so we can tuck up under that there tank and syphon off a few thousand gallons of JP-4 for our trusty air machine."

It took C.R.'s crew only a few moments to clean up all the checklists he had forgotten to call for, and soon they were all anxiously monitoring his first *operational* hook up.

"Albert 89, this is Gasser 62. You're cleared into the contact position." The '135 boomer had a confident voice that bespoke thousands of successful refuelings. Noting the C-5 beginning to accelerate rapidly, he remained calm and in charge. "Albert 89, Breakaway! Breakaway! Breakaway!"

"What in blazes is he talking about," muttered the Miffed Major as he yanked the throttles to idle and dumped the Galaxy's nose. "I had it made. All that rookie had to do was stick the nozzle in the receptacle. I think I'll have a chat with his commander when we get home."

"Albert 89, Gasser 62.

You're cleared back into the precontact position." The boomer's voice was still outwardly calm, but had a decided edge to it. "This time, though, please monitor your closure rate. If you'd have been coming forward any faster, we'd now be in contact position behind *you*."

C.R. glared around the cockpit as his crew poorly supressed various chokes, snorts and giggles. His crimson face was ample proof that the boomer's remark had struck home.

"Albert 89, you're cleared into the contact position." The boomer released the mike button and sighed, readying himself for another suicidal charge by the gray and white monster behind him. But this time he was surprised—pleasantly surprised—because the C-5 glided smoothly into the contact position and stopped, perfectly stable and awaiting the boom.

C.R. grinned as seconds later he heard the reassuring thunk of the boom latching securely into the C-5's AR receptacle. "Nice shot, Boomer," he drawled confidently over the radio. "Now how's about filling us up and doing the windows. Check under the hood too, if ya got time." C.R relaxed and leaned back in his seat. AR was a piece of cake. Then it started!

The commands began slowly, but were soon coming in rapid succession. "Left two. Back five. Down three. *Back eight! Down ten!*"

"Give me a chance, will ya?" C.R. snarled as he moved the controls so rapidly his hands and feet were mere blurs. His overconfidence was a thing of the past.

"Boss, you're starting to overcontrol. Better disconnect and move back to stabilize." Sammy's advice was correct, but too late.

Realizing he was well back in the envelope, the Titan of the Throttles pushed the power to the firewall. "That oughta get us back into position," he panted, sweat trickling into his eyes. "Just a simple case of mind over matter. I'm not gonna look like some rank amateur on

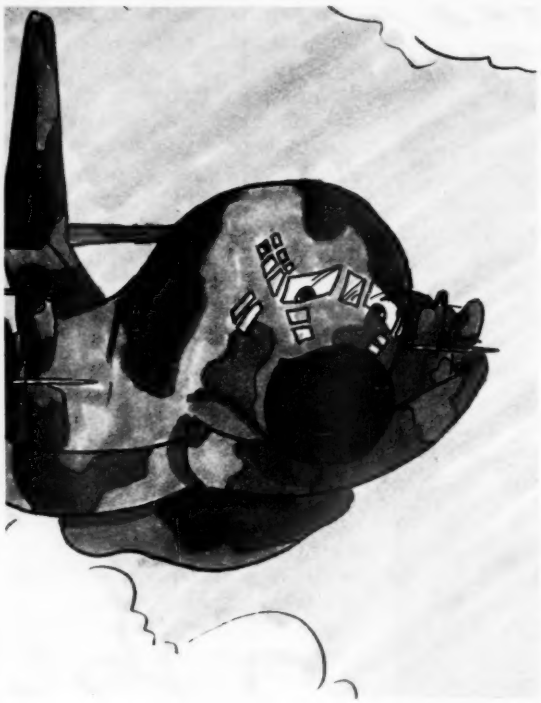
my first AR. No sir! I never initiated a disconnect, and I'm not about to start now!" He snarled defiantly as the C-5 literally leaped forward, engines now spooled up to nearly full speed.

"BREAKAWAY! BREAKAWAY! BREAKAWAY! The boomer screamed the warning well before the nose of the Galaxy disappeared beneath him and the tankers' boom began to bend. "Albert 89, acknowledge breakaway!" He continued to yell instructions as the Galaxy continued ominous forward movement.

POW! BANG! CRUNCH! The sounds of ripping metal were unmistakeable in both cockpits. As the C-5 slowed, then began to drop back and below the tanker, the boomer groaned. For there, stuck firmly in the C-5's receptacle was what was left of his boom. Dejectedly he pushed his mike button. "Albert 89, this is Gasser 62. Discontinue AR. You just ripped off our boom and it's sticking out of the top of your aircraft. Gasser 62 is RTB!" Abruptly, the KC-135 peeled up and away, the mangled stump of the boom clearly silhouetted against the blue sky.

C.R. moaned and wiped his brow, all pretext of confidence now destroyed. Then he slowly turned and fixed his crew with a baleful stare. "I don't know how that inept boomer managed to break off that boom in our aircraft, crew. But I do know one thing. The first person on this crew who even *mentions* the word *unicorn* will spend the next six months dipping septic tanks in the base camping area!" ✯

Quick Stoppers

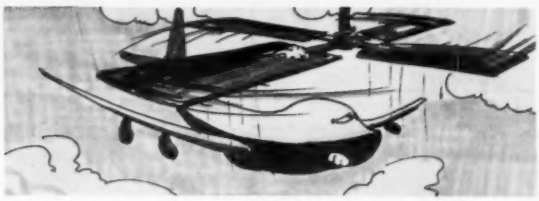


B-Model Bends

The C-130 was involved in a test program which required multiple depressurizations at 18,000 feet MSL. Passing through 13,000 feet on the third descent from 18,000, though, one of the Herk's crewmembers stated he was experiencing slight shoulder pain. The crew returned to their base and had the aircraft met by an ambulance and a flight surgeon. The crewmember was transported to a nearby hyperbaric treatment chamber where he was pressurized for approximately three hours. Once in the pressurized environment, his pain subsided, indicating the most probable cause of his discomfort was evolved gas bubbles in the shoulder joint. Anytime you operate an aircraft unpressurized at other than low altitudes, you run the risk of an evolved gas problem. Know the symptoms, and if someone on your crew experiences them, get him or her to qualified medical assistance immediately.

Airplane, Airplane. Who's Got The Airplane?

The Starlifter crew was being vectored to a strange field and the copilot was flying the approach. Because there were no instrument approaches available to the active runway, the crew planned a visual approach, well aware a visual illusion might cause them to appear steep on final. Shortly after setting up on final, though, the copilot thought the approach looked *much* too steep, so he requested clearance for a visual right base approach. The second approach looked equally steep, but the AC told the copilot to stay with it. The copilot then noticed the aircraft responding to control inputs he was not initiating, so he began to follow through on the controls. The C-141 crossed the threshold at 250 feet AGL, 20 knots hot, and floated down the runway nearly 4,500 feet before the crew began an emergency go-around. The copilot reached to reset the flaps and noticed the throttles were not moving forward. He quickly pushed forward on the throttles, but they wouldn't move—they were stuck! With the end of the runway rapidly approaching, the alert engineer yelled for spoilers, which the copilot quickly deployed as the AC went to full reverse and began maximum braking. Fortunately, the C-141 stopped 500 feet short of the end of the runway. Although the crew was able to duplicate the stuck throttles one more time, maintenance was unable to find anything amiss when they dismantled the throttle quadrant. Good thing this out-of-sync crew decided who was flying the aircraft in time to stop. Good thing the runway wasn't 1,000 feet shorter, too!!



Experience Saves The Day

Taken directly from NASA's *Callback*, this one is really thought provoking, especially when you mention severe weather, thunderstorms, wind shear, or microburst in the same breath.

"...Glide slope was intercepted at 4,000 feet and flown throughout the entire approach with little or no deviation...At 200 feet above the ground, a sudden downburst or severe wind shear was encountered. There was a line of thunderstorms to the west... Ceiling was 5,000 feet over the airport with unrestricted visibility. No wind shear or turbulence was being reported, and only minor bumps were encountered during our approach. Surface wind was reported as nine knots...We entered some light turbulence that was followed quickly by a sudden excessive sink rate and rapid airspeed loss. I was carrying eight knots above reference speed—130 percent of stall—and had not yet reduced thrust to final descent value. When the airspeed dropped off, my hands were still on the power levers, and my reaction was almost instantaneous—no delay in shoving the throttles clear to the firewall. Engines responded quickly, but not quickly enough to recover from a 45-knot drop in airspeed. As throttles were advanced, pitch increase was initiated to stop the sink. A 'maximum performance' effort was made to fly out of the sink rate condition with intermittent stick-shaker activation. We barely made the runway with our main gear and hit hard...100 yards further out on the approach and we would never have made the airport...lucky to have been in the configuration we were in and with extra airspeed...more than we could have handled without a little airspeed advantage."

This one is so scary, we can't think of anything else to say!

ARRS *Callback*

Ice FOD

The mission for this AFRES HH-3 crew started normally enough with a briefing at the local weather shop. All the forecaster had of any significance was that the crew would encounter icing if they flew above 6,000 feet MSL. But after 2½ hours of flight at 3,200 feet, the crew noticed a slight build-up of ice on the windshield wipers, hoist, and the aux tip tanks. The crew requested and received a lower altitude, and started a descent to 2,700 feet. Sometime during the descent, ice was apparently ingested into the number-two engine, accompanied by what the crew described as a soft "bang." After leveling at 2,700 feet, the crew rechecked all engine, transmission and hydraulic instruments and found nothing amiss. Prudently, the crew decided to put the HH-3 down in a field to check out any possible damages. Following an uneventful landing and engine shutdown, the crew chief gave both engines the once over, finding some minor damage to the number-two engine in the form of compressor blade nicks. But another problem quickly surfaced.

It seems the Jolly Green had started to sink slowly into the soft field—actually Kentucky blue grass. Anyway, the crew decided that getting transportation to the fairly remote landing site was tantamount to impossible, so perhaps a short flight to a nearby civilian airfield would be better than trying to raise their steed from the mud. After running thorough accel/decel checks on both engines, the crew then performed a hover check. Everything checked out just fine, and the crew flew on to the civilian airport where they landed safely.

Quick Stoppers

Ouch! That Smarts!

It was a normal training flight for the crew of the UH-60, even though the mission profile did call for a climb to 13,000 feet MSL for a parachute test. Level at 13 grand, the Blackhawk maintained the altitude for approximately 10 minutes before deploying a pararescueman who was testing a new ram air canopy. Jumper away, the AC began a descent to pattern altitude, but was forced to level at 5,000 feet when the flight engineer complained of sinus and left ear blocks. The pilot then climbed back to 10,000 feet in an attempt to assist the engineer in clearing his ears and sinuses, but the try was in vain. Out of options, the crew descended and landed at a nearby USAF hospital helipad where the engineer reported to the flight surgeon. Luckily, the doctor cleared the ear and sinus blocks with a decongestant and the engineer suffered no injuries. After a short DNIF period, the engineer returned to flight status.

Cotter Key Catch

Noticing binding ailerons is exciting, but noticing that same binding during an air refueling rendezvous has got to be thoroughly traumatic. But that's exactly what happened to the crew of an AC-130 recently. Wisely, they terminated the AR and headed for the homedrome, doing a little troubleshooting on the way (no, they didn't use the 105 mm gun for the troubleshooting). The crew noted that an air duct appeared to be interfering with the movement of the aileron linkage. Following an uneventful approach and landing, the crew turned the Herk over to the maintenance folks who followed up on the crew's observation. The maintainers found that the "end cap" cotter key on the aileron boost-pack actuator arm was catching on the fiber insulation of the overhead left-hand air duct. There was a fairly deep gouge through the insulation material, and the ends of the cotter key were snagging the material whenever the aircraft yoke was turned to the right. It appears the cotter key was installed from the bottom during boost pack manufacture or overhaul, allowing the end of the key to snag the insulation. *Editors' Note*--Because of the problem with cotter key installation, HQ MAC/LGMW ordered a one-time inspection of the aileron boost-pack "end cap" cotter key installation on all MAC C-130s, and directed that all such cotter keys be installed with the heads up and the ends bent snuggly around the end cap. Additionally, the LG folks told the C-130 maintainers to inspect the fiber insulation around the adjacent air ducts to ensure clearance between the actuator arm and the insulation when the aileron controls are operated.

After Deadlines

ANTARCTICA RESUPPLY—A MAC C-141 from the 62d MAW, McChord AFB, Washington, recently participated in the aerial resupply of McMurdo and South Pole stations in Antarctica. Supported by SAC KC-10s, the Starlifter crew airdropped 65,000 pounds of fresh food, medical supplies, repair parts and mail to the 84 sailors and civilians wintering-over on the frozen continent. The airdrop bundles were prepared by packers and riggers from the Air Force, Army, Navy and Royal New Zealand army, and included the first *successful* aerial delivery of watermelons to Antarctica.

SPECIAL OPS UNIT OF THE YEAR —The 16th Special Operations Squadron, Hurlburt Field, Florida, is the Military Airlift Command's outstanding special operations squadron of 1983. Selected from among special operations squadrons around the world, the 16 SOS was a part of the multinational force that liberated Grenada and rescued American students from the island. The unit's AC-130 Spectre gunships were especially effective in silencing numerous gun positions and armored personnel carriers during the mission. Said Lt. Col. David Sims, 16 SOS commander, "This honor is not only for us, but for all of Hurlburt Field." Congratulations from *The MAC Flyer*.

60TH MAW SPONSORS OUTSTANDING SQUADRON—Sponsored by the 60th Military Airlift Wing, Travis AFB, California, the Thirtieth Squadron was recently selected as the outstanding Air Force Academy cadet squadron for 1984. Academy officials evaluated the overall military, academic, and athletic performance of all 40 cadet squadrons before selecting the Thirtieth for the honor. The 60th MAW has sponsored the squadron for the past two years, with members of the 60th MAW visiting the Academy last October and members of the Thirtieth touring Travis in April. The Academy's Squadron Sponsor Program seeks to associate each cadet squadron with an operational Air Force Unit so that cadets gain first-hand knowledge of Air Force life and the sponsoring units, in turn, understand the Academy's mission.

SAFETY OFFICERS PROMOTED TO MAJOR—MAC will have 12 additional field grade safety officers in the near future, thanks to the recent majors promotion board. No, that's not 12 additional slots; rather 12 of the command's safety officers were promoted to major. Safety officers promoted were Stephen Behr, 1400 MAS; Robert Bolton, 1402 MAS; Douglas Cain, Det 3, 625 MASG; John Codella, HQ MAC; Norvin Davis, 625 MASG; Al Gardner, 616 MAG; George Harper, 322 ALD; Ben Horton 374 TAW; Steve Jones, HQ MAC; Carl King, 58 MAS; E.S. (Sandy) Richardson, 22 AF; and Hal White, 313 TAG.

C-141 CRASHES NEAR SIGONELLA—On 12 July, a C-141 from the 437th MAW, Charleston AFB, South Carolina, crashed shortly after departure from Sigonella NAS, Italy. All nine persons on board, including eight crewmembers from the 315 MAW (Assoc) at Charleston and one passenger, were killed in the mishap.

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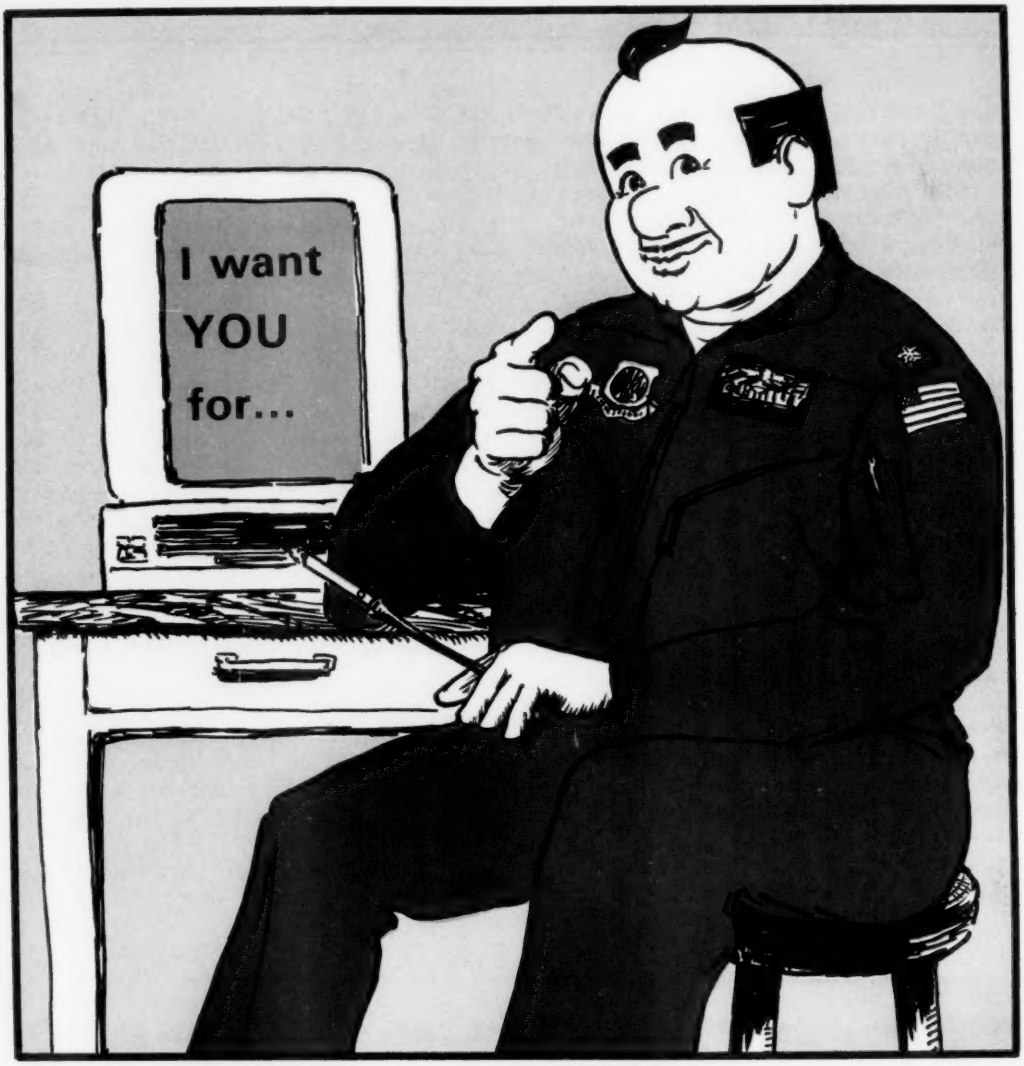

THE MAC Flyer

SUPERVISING EDITOR VACANCY FOR *The MAC Flyer*—We have an opening in May-June 1985 for the Supervising Editor of MAC's flight safety journal. We need a newly minted major with MAC flying experience, preferably in strategic airlift. Ambition and the ability to tell a good story are strong qualifications for this position. Flight safety and/or public affairs experience is a plus. Interested officers should contact Major Jim Lee, Supervising Editor, Autovon 638-5542, or write HQ MAC/IGFE, Scott AFB, IL 62225.